JAN 1 4 1988

NAS 1-53 : OSSA-4-88

October 5, 1988
A.O. No. OSSA 4-88

NF-OSSA-4-88

NASA
National
Aeronautics and
Space
Administration

Announcement of Opportunity

FLIGHT EXPERIMENTS FOR MICROGRAVITY SCIENCE AND APPLICATIONS PROGRAM

Letters of Intent Due: November 4, 1988
Proposals Due: January 3, 1989

COMPLETED

ANNOUNCEMENT OF OPPORTUNITY
FOR
FLIGHT EXPERIMENTS FOR THE
MICROGRAVITY SCIENCE AND APPLICATIONS PROGRAM

Table of Contents

I. Description of the Opportunity
II. Announcement of the Objectives
III. Background
IV. Proposal Opportunity Period
V. Supplementary Proposal Preparation Information
VI. Requirements and Constraints
VII. Proposal Submission Information
VIII. Proposal Evaluation, Selection, and Implementation
IX. Proposal Schedule
X. Appendices
- A. Hardware Descriptions
- B. General Instructions and Provisions
- C. Guidelines for Proposal Preparation
- D. Generic Principal Investigator (PI) Activity Schedule
- E. Bibliography

I. DESCRIPTION OF THE OPPORTUNITY

The National Aeronautics and Space Administration (NASA) announces an opportunity to conduct research in the areas of materials science, fluid dynamics and mass transport, combustion science, biotechnology, and fundamental physics and chemistry in the space environment, utilizing the capabilities of the National Space Transportation System (NSTS) Space Shuttle. The Office of Space Science and Applications (OSSA), Microgravity Science and Applications Division (MSAD) is embarking on a phase of the program in preparation for the Space Station Freedom era that will include several flight opportunities on Spacelab missions. In preparation for these missions, four major multiuser pieces of equipment are being developed for flight on the United States Microgravity Laboratory (USML), the first of which is scheduled for flight in 1992. In addition, foreign partners in space ventures have offered equipment that can be flown on International Microgravity Laboratory (IML) missions, primarily the IML-2 mission, currently manifested in 1993. This Announcement requests proposals related to use of the four pieces of multiuser equipment being developed by MSAD for the USML missions and for use of the foreign equipment being offered for the IML-2 mission. Proposals are also requested for use of other pieces of equipment listed in this Announcement which could be accommodated on these or other flights. Foreign participation on US equipment would be accommodated within the IML program. The number of proposals selected will depend on availability of funding.

Readers of this Announcement should realize that this will not comprise the only invitation to submit a proposal to NASA to gain access to the space environment. The Spacelab missions and other launch opportunities are an ongoing process and other Announcements will be issued as opportunities become available for new investigators. In addition, a NASA Research Announcement (NRA) will be issued in the near future to solicit research proposals for ground-based research programs that may evolve to a level of maturity for consideration as flight experiments.

This Announcement is intended for NASA-funded (or foreign-funded) research and requires that the results of such research be made available to the public. There are alternative mechanisms available to those seeking to retain proprietary interest which require private funding. Information on these alternative mechanisms is available from Mr. G. C. Misener, Jr., NASA Headquarters, Office of Commerical Programs, (Code CCL) Washington, DC 20546, (202) 453-2118.

II. ANNOUNCEMENT OBJECTIVES

The objectives of this Announcement of Opportunity (AO) are to:

1. Select high quality science experiments to be carried out in multiuser equipment which will be available for flight in the near future.
2. Select experiments which, when carried out in space, will lead to an increase in understanding the role of gravity on Earth-based processes and materials or in understanding fundamental phenomena related to the science disciplines encompassed by the MSAD program.
3. Select experiments that elucidate industry-driven science requirements for research in the space environment.
4. Broaden participation in the MSAD flight research program.
5. Select experiments that may lead to the development of new processes or processing techniques that are unique to the low gravity environment.

These objectives will facilitate the achievement of the goals of the MSAD to utilize the space environment to carry out a comprehensive program of basic and applied scientific research in the areas of materials science, fluid dynamics and mass transport, biotechnology, combustion science, and fundamental physics and chemistry. Brief descriptions of the capabilities of the equipment to be emphasized in this AO are given in Appendix A, but more detailed descriptions can be requested in the Letter of Intent described in Section VI.1. The equipment will be able to accommodate studies in the following areas: The measurement of thermophysical properties or production of benchmark materials; directional solidification of semiconducting crystals, metals or metal alloy systems, and electro-optic materials; glass forming materials; high temperature superconductors; protein crystal growth; cell maintenance and separation techniques; combustion science; and fluid dynamics and mass transport.

III. BACKGROUND

As stated in NASA Microgravity Strategic Plan-1988, the NASA microgravity program has goals to:

1. "Conduct a comprehensive research program in materials science, biotechnology, and fundamental physics, chemistry and biology through investigations in space."
2. "Develop and demonstrate new technologies, materials, and processes relevant to basic research and commercial applications through utilization of the space environment."
3. "Establish a permanently manned, multifacility national microgravity laboratory in low-Earth orbit to provide a long duration, stable microgravity environment. In addition to its other functions, the Space Station Freedom would also be the centerpiece of this capability."

To achieve these NASA goals, the MSAD is to establish a experimental results database which determines the potential of the near Earth environment as a resource for carrying out research which cannot be accomplished on Earth and for determining the potential for exploitation of that environment for future commercial applications. One part of the program is to develop equipment designed for specific Principal Investigator's scientific requirements to challenge existing theories and expand the scientific understanding of physical and chemical phenomena related to the research disciplines of interest to the academic and industrial communities in the United States. The part of the program addressed in this AO is to utilize multiuser hardware to conduct experiments to establish the aforementioned database.

NASA has manifested a series of Spacelab flights which offer scientists an opportunity to conduct experiments in the hands on environment of the Spacelab in order to define the potential advantages of carrying out research in space. In preparation for the United States Microgravity Laboratory (USML) series of flights, the MSAD has built or initiated the development of the multiuser equipment described in this AO. In addition, the International Microgravity Laboratory (IML) series of Spacelab missions offers the opportunity to utilize US equipment and the equipment built by the space programs in other countries on a cooperative basis. These missions, along with other opportunities for flight of secondary payloads in the middeck area and in the cargo bay of the Shuttle for unmanned experiments, comprise the MSAD program to give U.S. investigators an opportunity to participate in the MSAD flight research program.

The proposals selected from this AO will provide data from high quality scientific investigations carried out in space that will establish the basis for achievement of these goals. It is expected that the results of the investigations selected will advance the understanding of the science involved in, but is not limited to, all the areas listed is Section II. The results will be used by MSAD to develop a detailed plan that will evolve to an optimum utilization of the Space Station as a national research laboratory and to indicate to the commercial research community the potential advantages of commercial utilization of the space environment.

This AO is concerned primarily with opportunities associated with the USML-1 and the IML-2 mission, although approved proposals, with the permission of the PI, will be considered for other flights if they cannot be accommodated on these missions. Investigators who are interested in becoming involved in the program but feel restricted by the urgent nature of this AO are invited to plan to propose against the later editions of this AO or the NRA for the ground-based program which will be issued in the near future.

IV. PROPOSAL OPPORTUNITY PERIOD

To receive full consideration, proposals must be received at the address listed in Section VII no later than 4:30 p.m. EST January 3, 1989.

V. SUPPLEMENTARY PROPOSAL PREPARATION INFORMATION

The information contained in paragraph VI through IX is applicable only to this Announcement and supplements or modifies the information contained in General Instructions and Provisions and Detailed Guidelines for Proposal Preparation extracted from NASA Federal Acquisition Regulation Supplement (NFS) 18-70 contained in Appendix B and C.

VI. REQUIREMENTS AND CONSTRAINTS

Investigators to be selected through this solicitation must propose scientific hypotheses and a series of experiments to test these hypotheses that can be accomplished within or very nearly within the capabilities of the equipment described in this Announcement. The selected PI's will be required to have developed or to quickly develop the experimental techniques and characterization techniques required to test or verify these hypotheses and to define the optimized space experiments that need to be carried out in order to advance the state of the art in the subdiscipline they have chosen to address.

Investigators will be funded to implement the necessary ground-based research in their laboratory to clarify and optimize the science requirements for the flight experiment. They will be required to work with the Project Scientist to develop a Science Requirements Document which describes the background and justification for their flight experiment. They will then be required to work with engineering teams who are building the equipment to develop an Experiments Requirements Document (ERD) to assure that their science requirements are adequately defined and met. They will be required to analyze the space results and present the data and results in the open literature within one year of the flight date. They will be required to team with other Principal Investigators (PI's), who are selected for the same flight, in order to utilize most effectively the resources that will be available during the space flight and to obtain the highest possible science return for the overall mission. A generic Principal Investigator activity scenario is provided in Appendix E.

The number of proposals selected for award will depend on the results of the evaluation of the proposals and the availability of funds. Although not limited by this, past experience has shown that efforts similar to those requested here require the equivalent of part of the PI's time, a junior research scientist (post-doctoral or research associate position), and on the average, one or two graduate student equivalents.

Academic/industrial partnerships in which the industrial partner is willing to cost share or provide in-kind services are encouraged but not required.

VII. PROPOSAL SUBMISSION INFORMATION

The following guidelines provide procedural and format information for submission of proposals to participate in the Flight Experiments for the Microgravity Science and Applications Program. This solicitation emphasizes investigations that ultimately require experimentation in the space environment.

A. Letter of Intent

Organizations planning to submit a proposal in response to this AO should notify NASA of their intent to propose by sending a Letter of Intent to:

Code EPM-20 (MSAD)
(AO No. OSSA-4-88)
NASA Headquarters
Washington, DC 20546

When the institution sponsoring a proposal to NASA is from any country other than the United States, and US proposals which contain foreign participants, the Letter of Intent should be sent to the address above and a copy to:

International Relations Division
Code XID (AO No. OSSA-4-88)
National Aeronautics and Space Administration
Washington, DC 20546 USA

The Letter of Intent, which should not exceed two pages in length (8 1/2 X 11, 10 or 12 pitch) must be in English and must include the following information:

- The potential Principal Investigator's (PI's) name, position, organization, address, telephone, telex, and telefax number
- A list of potential Co-Investigator's (Co-I's) names, positions, and organizations
- Specific scientific/technical objectives of the project
- The equipment of interest listed in this AO

The Letters of Intent must be received by NASA Headquarters no later than 4:30 p.m. EDT, November 4, 1988. Material in these letters is requested for informational and planning purposes only and is not binding to the signatories. In the Letter of Intent, investigators may request more detail on the capabilities of the

specific equipment that might be utilized to accomplish their scientific objectives. Such information may also be requested from the Microgravity Science and Applications Division, Attn: Dr. R. Crouch, Code EN, NASA Headquarters, Washington, DC 20546, (202) 453-1490.

B. Proposal Content and Format

The purpose of the proposal is to describe the objectives and significance of the proposed research; the relevance of the proposed research to the objectives given in the AO; the approach to be taken; the data acquisition and analysis plan; qualifications of the proposed investigators and of their institution to carry out the proposed work; and an estimate of the resources required to accomplish the stated objectives.

A uniform proposal content is required to aid the reviewers during proposal evaluation and to facilitate comparative analysis. All proposals must be in English. The proposal must be submitted in two sections: Investigation and Technical Plan (including appendix), and Management and Cost Plan. The cost plan can be omitted for foreign proposals. The proposal text should be single-spaced and the original copy should be printed on only one side of each page (8 1/2 X 11, 10 or 12 pitch). The text addressing the requirements of Appendix C, Section I, shall not exceed a total of 20 pages. Inclusion of pertinent references as an appendix attached to the individual proposal copies is encouraged. Supplemental information may be attached as appendices, but NASA does not guarantee to use the information in the evaluation of the proposal. Twelve (12) copies, including the original must be submitted. The proposal must contain the information and must be assembled in the format described in Appendix C. Material in excess of these guidelines will not necessarily be reviewed.

C. Proposal Submission Information

Twelve (12) copies of each proposal should be submitted to NASA. At least one complete copy of the proposal must be signed by the PI's institutional officials authorized to commit institutional support, sponsorship of the investigation, and the technical and financial management aspects of the proposed project. Proposals should be sent to:

Code EPM-20 (MSAD)
(AO No. OSSA-4-88)
NASA Headquarters
Washington, DC 20546

Non-US proposals (see Appendix C) should be mailed to:

International Relations Division
Code XID (AO No. OSSA-4-88)
National Aeronautics and Space Administration
Washington, DC 20546 USA

VIII. PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

A. Evaluation of Proposals

Proposals received in response to this AO will be reviewed and selected in accordance with the procedure stated in NASA Federal Acquisition Regulation Supplement (NFS) 18-70. (NFS 18-70 replaces NASA Handbook 8030.6.) Note specifically that proposals may be evaluated by contractors selected by NASA. If any part of the proposal is indicated as not releasable outside the Government for evaluation purposes, the proposal cannot be evaluated under this AO. All proposals received by NASA in response to this AO will initially be screened by MSAD program and project scientists to determine their responsiveness to the objectives stated in Section II. Proposals considered nonresponsive will be returned to their authors immediately with a written explanation of this determination. Such proposals will not be considered further by NASA.

The evaluation process for AO OSSA-4-88 will consist of a two panel review. The Evaluation Panel, composed of scientific and technical experts from government, academia, and industry, will be convened to review, assess, and grade proposals in the areas of scientific and technical merit, management, and feasibility in accordance with the criteria presented below, excluding costs.

The report of the Evaluation Panel will be forwarded to the Categorization Panel for review. Proposals reviewed and graded by the Evaluation Panel will be assessed by a Categorization Panel composed of NASA employees and chaired by the MSAD Chief Scientist. The categorization process ranks proposals into categories as defined in NFS 18-70.

B. Selection Information

The Chairman of the Categorization Panel (MSAD Chief Scientist) will present the results of the panel assessment, including appropriate rationale for the recommended program, to the Space Science and Applications Steering Committee for review and transmittal to the NASA Selection Official, the Associate Administrator (AA) of OSSA. The AA will make the final selection based on panel recommendations. Upon completion of deliberations, a selection statement will be released notifying offerors of proposal selection or rejection.

C. Evaluation Criteria

The selection of proposals which best meet the objectives stated in Section II of this AO is the fundamental aim of the investigation acquisition process. To achieve this aim, the criteria listed below, in descending order of importance, have been established for the evaluation of all proposals submitted under this AO:

1. The overall scientific and technological merits of the proposed investigation, including the topical importance of the proposed study within a specific disciplinary field and the probability of achieving positive results.

2. The relevancy of the proposed investigations to the goals and objectives stated in this AO.

3. Ability to achieve major science requirements utilizing one of the pieces of equipment described in Appendix A, with little or no modifications.

4. The adequacy and completeness of the data reduction and analysis plan. This could include establishment of innovative or unique data acquisition or characterization techniques.

5. The qualifications, capabilities, and experience of the proposed PI, Co-I's and key personnel who are critical in achieving the proposal objectives.

6. The institutional capabilities, related experience, facilities, techniques, or unique combinations of these, which are integral factors for achieving the proposal objectives.

7. Potential contribution of the effort to NASA-related research, particularly in the subdiscipline areas of electronic materials, metals and alloys, glass and ceramics, fluid dynamics and transport phenomena, combustion science, physics and chemistry of fundamental phenomena, and polymer science.

8. Overall standing among similar proposals available for evaluation.

9. Cost considerations.

10. Other factors such as a duplication of research thrusts with current NASA activities, available budget, and program balance.

NASA reserves the right to negotiate the scope of work, duration, and funding for any proposed project. Approved projects will be funded under a contractual agreement.

IX. Schedule

The following schedule is applicable to this AO:

1.	Letter of Intent	November 4, 1988
2.	Proposal Submittal	January 3, 1989
3.	Target Date for Announcement of Selection	April 15, 1989
4.	Earliest Date of Contract Funding	August, 1989
5.	Launch Readiness Date of USML-1	March, 1992
6.	Launch Readiness Date of IML-2	October, 1992
7.	Launch Readiness Date of USML-2	July, 1993

The Flight Experiments of the MSAD provide a new opportunity for investigators to become part of NASA's program to carry out a multidisciplinary research program in low Earth orbit. I look forward to receiving many imaginative and innovative proposals for flight on the Spacelab.

Sincerely,

L.A. Fisk
Associate Administrator for
Space Science and Applications

APPENDIX A

The US equipment described in this section is planned for development by NASA for flight on the USML missions. The foreign equipment described has been offered for flight on a cooperative basis by agencies from the various countries for flight on the IML missions. The priorities for flight of this equipment will be determined in part by the proposals submitted in response to this AO.

HARDWARE DESCRIPTIONS

I. US HARDWARE FOR THE United States Microgravity Laboratory (USML) MISSIONS

A. Modular, Multiuser Flight Equipment Capabilities

This Section provides a general description for each of the four major, multiuser equipment modules to be developed for USML program. These modules include the Crystal Growth Furnace, Metals and Alloys Solidification Apparatus, Acoustic Levitation Furnace, and a Drop Physics Module. Each is discussed below.

1. Crystal Growth Furnace (CGF). The CGF will be a modular, directional solidification furnace having the capability for on-orbit exchange of samples. Heater modules in the furnace are interchangeable, but it is not anticipated that they will be changed on-orbit during the USML-1 mission. The furnace will be designed to accommodate investigations of phenomena that occur during directional solidification of electronic materials and metals and alloys in a low-gravity environment. The system will permit operation of the furnace with interaction by the crew and/or from the ground.

The multizone furnace has a high-temperature capability in the 1600 C range and a low-temperature portion that will go up to 1200 C. It will have a booster heater near the center of the furnace to allow for a more definitive control of the temperature gradient in the solidification region. It will have a capability for current pulsing through the sample to allow interface demarcation.

2. Metals and Alloys Solidification Apparatus (MASA). The MASA will accommodate research studies that involve the solidification of metals and alloys. The furnace will be modular to accommodate a variety of experiment thermal requirements and allow rapid changing of components between flights, and will be flown in the Spacelab habitable module. Samples processed in the furnace will be large enough to be tested for strength.

The MASA will be able to process up to 20 samples per mission, melting and rapidly cooling each sample at a controlled rate.

The apparatus will have the capability to provide a highly efficient, rapid, liquid and/or gaseous quench for the samples. As the furnace moves along the length of each sample, which remains stationary to reduce acceleration influences on the process, the sample will be subjected to a hot zone in which temperatures can reach 1600 degrees C, a cold zone with quench capability, and an insulating (adiabatic) zone that separates the hot and cold zones.

The furnace translation rates will range from 0.06 to 1200 millimeters per hour to accommodate the directional solidification process. The length of the adiabatic zone can be preset to accommodate various axial temperature gradients desired by the investigator for the sample being processed, and the furnace's rate of movement will be programmed for individual sample runs. The MASA design also allows investigators on the ground to control experiments.

3. Acoustic Levitation Furnace (ALF). The ALF will be a containerless processing hot wall furnace for high-purity processing and for melting and undercooling studies of high-temperature glass, ceramic, metal, and alloy specimens in a containerless microgravity environment. This facility will consist of an acoustic levitation system using multiple transducers, with a 1750 C hot wall furnace capable of processing, heating, melting, soaking, cooling, and solidifying samples without the physical contact of a container. This facility will accommodate a large number of nominally spherical samples 2-6 mm in diameter, thus allowing a number of different experimental programs to be supported.

The acoustic levitation system will provide special stability of the specimen position to maintain the containerless condition. The overall sound pressure is electronically adjustable by computer control and can be used to modulate the liquid sample shape to possibly study drop fluid dynamics or to measure physical properties, such as surface tension and viscosity. By properly phasing the acoustic signal to two axes, spin in the specimen can be produced.

During all stages of processing, there will be video imaging of two orthogonal views of the specimen, as well as thermal imaging of the specimen at several possible different optical wavelengths, thus providing noncontact, user-calibrated temperature measurement capabilities. Specimens may be processed in gaseous environments consisting of air, argon, nitrogen, or mixtures of these gases.

Other gases may be possible. The specimen environment will have active as well as passive gaseous and particulate contamination control measures, primarily gas purging. Occasional venting to space of moderate quantities of nonhazardous gases is anticpated.

4. Drop Physics Module (DPM). The USML-1 DPM is a multiuser, acoustic positioning instrument system designed to accommodate ambient, and elevated (<800 degrees C), temperature investigations under microgravity conditions. Heating rates greater than 1 degree C per second are planned; but the constraints of the Spacelab on the use of power may impact the heating rates and duration. Controlled environmental parameters will include temperature, hydrostatic pressure, nature of the host gases, humidity, lighting, and positioning force. High sample temperature will be achieved through the use of a resistive furnace and, probably, beam heating.

The mechanization of the sample heating system will depend upon the optical properties of the samples under test and experiment cooling rate requirements.

Optical viewing (2 orthogonal views at 30 frames per second) and recording will be provided with variable frame rates. Two levels of magnification, standard and zoom, will also be provided. It is probable that higher frame rates may be available through the use of video or cinefilm techniques. A set of different lighting configurations will allow sample edge resolution, vibrational motion detection, and visualization with transparent liquid samples containing tracer particles.

Sample rotation, positional and shape oscillation, and translation within the processing chamber can be induced as required. Sample position stability is expected to provide position fluctuation of =+- 1.0 mm at equilibrium, with maximum amplitude of transient fluctuations of <+/- 5.0 mm for low frequency cases and a dc residual acceleration level below 0.0001 "G". The capability for nulling the acoustic force for up to five minutes will also be provided during periods of low dc residual acceleration provided the initial velocity of sample release is less than 100 microns per second. Rotational control should be less than 0.1 revolutions per second. Shape distortion can be held to less than 1 percent from sphericity for a drop diameter of less than 2.5 cm.

Both liquid and solid samples will be deployed into an appropriate chamber, and retrieved or disposed of after the experiment has been completed. Noncontaminating sample storage and processing will also be provided.

B. OTHER HARDWARE THAT WILL BE CONSIDERED FOR FLIGHT

1. Bioreactor. The Space Bioreactor is a cell and tissue culture instrument with the capability for media perfusion, controlled nutrient delivery, and controlled dissolved gas pressures. A process computer allows the user to manipulate and log culture parameters. The culture vessel is interchangeable to allow designs specific for particular applications. The current 55 ml vessel is optimized for mammalian cell culture on microcarrier beads. Samples of the culture and cell free media

may be obtained without disrupting the process. The Space Bioreactor is mounted in the Shuttle middeck in the position of two middeck lockers.

2. Fluids Experiment Apparatus. This apparatus was developed by Rockwell International under a Joint Endeavor Agreement (JEA) with NASA to accommodate commercial users. As part of the quid pro quo agreement, the apparatus can also be made available to NASA-funded science investigators. The apparatus fits into a middeck locker and can be configured for a variety of experiments in fluid mechanics and crystal growth. The present configuration will accommodate low-temperature float zone crystal growth. A variable frame rate recording system and a Hewlett Packard 110PC provides date acquisition.

3. Boeing Vapor Transport Furnace. This apparatus was developed by Boeing Aerospace Corporation under a JEA with NASA. Like the Fluid Experiment Apparatus, this apparatus is also available to NASA under the quid pro quo agreement for NASA-funded science.

The apparatus consists of a transparent, closed-tube vapor transport furnace that can operate at temperature up to 1000 C. The nucleation and growth of the crystal can be observed and controlled in real-time by the crew.

II. FOREIGN EQUIPMENT ON IML-1

Although this AO emphasizes the USML and the IML-2 opportunities, there is one piece of equipment on the IML-1 mission on which US PIs could be accommodated.

1. Cryostat. The Cryostat is a device developed for conducting experiments on the crystallization of proteins. It was successfully flown on the SL-1 mission. The equipment allows for a protein solution and a salt solution to be mixed through a buffer solution on orbit. When the shutter separating the protein and the salt solution from the buffer is slowly removed under microgravity conditions, the species diffuse from opposite sides into the buffer, where crystallites of the protein can thus be formed. In the cryostat, two identical containers are accommodated, each allowing the processing of 4 samples. On the IML-1 mission, U.S. investigators will be allowed to choose up to half of the samples to be processed.

The thermal conditions during processing can be controlled rather accurately between -10 $^{o}_{C}$ and +20 $^{o}_{C}$ by means of Peltier heating and cooling elements. The sample temperature can be held constant at 20 $^{o}_{C}$ during storage periods prior and after processing.

III. FOREIGN EQUIPMENT OFFERED FOR IML-2

A. Centre National d'Etudes Spatiales (CNES) French National Center for Space Studies

1. Applied Research on Separation Methods Using Space Electrophoresis (RAMSES). This equipment is designed to study electrokinectic processes in a continuous flow separation device. It has a cross-flow illumination system which will allow the study of the shape of the injected sample. At the upper end of the electrokinetic chamber, there is a Ultravoilet (UV) spectrophotometer which measures the optical densities of the protein samples which can be correlated to concentration profiles. It also has the capability of applying ac or dc electric fields and can be used to study electrohydrodynamic effects in this kind of device.

2. Holographic Interferometry in two Orthogonal Directions (HOLIDDO). This is an instrument conceived to study transparent objects in a microgravity environment. It is a multiuser facility utilizing a holographic unit to analyze transient processes indicated by temporal changes in refractive index for study of such things as separation processes, kinetics of nucleation, diffusion processes, strain, etc. The core of the facility is an exchangeable test cell which can be adapted to the investigator's requirements within certain limits. Utilization of two perpendicular views of the test cell to form holographic images and CCD cameras with a resolution to about 30 microns, gives a very good coverage of the region of interest. Images can be viewed by the crew or can be transmitted to the ground.

3. MEPHISTO. The MEPHISTO apparatus is a sophisticated furnace for basic research that will define the influence of various parameters on the directional solidification of metallic alloys and doped semiconductors. In this apparatus, the relationship between crystal quality and well-defined growth conditions can be studied.

The MEPHISTO apparatus will process two stationary, rod-shaped samples simultaneously within its heater/cooler configuration. The furnace is brought to a predetermined temperature and then moved along the length of the samples at a specified rate. Experimenters are able to study solidification under varying growth conditions using the measurement of the Seebeck voltage to determine the temperature at the liquid-solid interface in one sample while using Peltier pulsing to mark the interface shape and position in the second sample.

This apparatus was developed under a joint agreement between NASA and the CNES which specifies that a U.S. Principal Investigator may be accommodated.

The CNES has offered three other pieces of hardware titled: CHRISTOPHE which is a piece of equipment for growing protein crystals.

Containerless Processing of Glasses by Gas Bearing (CPG) which is a piece of equipment for high temperature (about 1500 C) processing of glass forming materials.

Directional Solidification of Molten Salts (DSMS) which is a furnace for processing molten salts.

Unfortunately, details of this equipment are not available as the AO is being published. For investigators interested in these areas of research, the details will be available by the time of the response to the Letter of Intent. If the details are not available, the equipment will be withdrawn from consideration, and the interested investigators will be notified.

B. Deutsche Forschungs-und Versuchsanstalt fur Luft-und Raumfahrt (DFVLR)
German Aerospace Research Establishment

1. CRYOSTAT (CRY). Same as that described above. (II. 1)

2. Electromagnetic Containerless Processing Facility (TEMPUS). TEMPUS provides for the containerless processing of samples using electromagnetic positioning and inductive heating under ultra high vacuum conditions. Heating and positioning is generated by two independent RF systems operating at 400KHz and 100 KHz. Sample temperatures above 2000 C can be reached. Temperatures are measured by emissivity independent pyrometers. The pressure level of the chamber can be down to 10^{-7} Torr. Several samples can be processed per flight.

3. Gradient Furnace with Quenching (GFQ). The GFQ is optimized for directional solidification experiments, especially those requiring steep thermal gradients. It consists of a Bridgman type furnace with two individually controlled heating zones and a cooling zone (water cooled). The heater and the cooled zone are separated by an adiabatic zone (30 mm). The heating is adjusted such that the solid-liquid interface is located in the adiabatic zone (minimal radial gradients). The samples are contained in cartridges and when they are to be quenched, the furnace is displaced rapidly and for rapid quenching, water is ejected onto the sample from a radial nozzle system. Temperatures in the hot zone range from 400 to 1500 C and sample dimensions are 18 cm long and 9 mm diameter.

4. High Precision Thermostat (HPT). The HPT is designed for experiments requiring high precision temperature measurement and control. The temperature range is between 0 and 75 C under very precisely controlled thermal conditions. Allowances are made for

crew interaction to allow for change of time-temperature profiles on orbit, if desired by the scientist on the ground. Temperature ranges can be set from flight to flight but around the selected reference temperature, the range is 17 microdegrees and the resolution is 8.3 microdegrees.

5. Quasi-Steady Acceleration Measurement (QSAM). This equipment will provide acceleration measurements from a series of small accelerometers placed at different points around the spacecraft. This equipment is primarily designed to allow for a mapping of the acceleration environment on the Shuttle and could be considered as support hardware for experiments that require acceleration measurements during the processing of samples.

6. Zone Melting Facility (ZMF). This equipment offers five well insulated heating and two controlled cooling zones which enable the establishment of a defined temperature profile in the experiment cartridge. A central heater (1 cm) is flanked by two cooling zones and two isothermal blocks (12 cm each) and two after heaters (1 cm each). The experiments can be performed in quartz ampoules or metal cartridges with up to four thermocouples. Two thermocouples at each heater are available for temperature measurement and control. Processing is done by moving the heater assembly while the sample remains stationary. Maximum temperature in the central zone is 1500 C, with the isothermal and supporting heater going to 1000 C. Temperature differences between the central region and the isothermal block is 800 C max. Sample diameters up to 2 cm can be accommodated.

C. European Space Agency (ESA)

1. Advanced Gradient Heating Facility (AGHF). The AGHF is a Bridgman type gradient furnace consisting of a heated section (two individually controlled heaters on a thermal diffusor) separated from the cooled heat extraction section by a large adiabatic zone. The furnace assembly is displaced relative to the sample, which is kept stationary. A modular concept has been adopted for easy modification of the system to meet different requirements and for easy refurbishment. Presently two versions of the AGHF are foreseen:

Type I for Semiconductor Crystal Growth-Large sample diameter, maximum thermal stability.

Type II for metallurgical experiments: Large temperature gradients (smaller diameters) quenching of samples.

Sample temperatures go up to 1400 C and sample diameters are up to 2 centimeters. The furnace has a Peltier current pulsing capability. The furnace can move 14 cm and the useful processing stroke is about 8 cm.

2. Bubble, Drop, and Particle Unit (BDPU). The BDPU is a fluid science module for the study of phenomena in fluids. It is dedicated to the study of the behavior of bubbles, drops, and particles in transparent liquids. It consists of a fluid cell with a system for injecting bubbles or drops plus an observation system. The modular construction allows the changing of fluid containers during flight and the installation of different types of cameras. Mixing can be accomplished by mechanical or acoustical means. Thermal gradients and electric fields can be applied as external stimuli.

3. Critical Point Facility (CPF). This multiuser facility is designed to investigate near critical point phenomena in transparent fluids. It consists of two similar units with common electronics. Each side in core unit accommodates a thermostat with the experiment dedicated fluid cell, an acoustic (for mixing) or thermal (heating, cooling, or quenching) stimuli and diagnostic devices. Additional slide-in units can be carried on board in order to accommodate up to 4 experiments per flight.

D. National Space Development Agency of Japan (NASDA).

Material Experiment Laboratory (MEL). The MEL is a configuration which incorporates all of the hardware described below. Elements can be flown individually or as a composite unit. All of the equipment offered are similar to that equipment to be flown on Spacelab J as part of Japan's First Materials Processing Test (FMPT) program.

a. Gradient Heating Furnace (GHF). The GHF is a travelling heater-type, vacuum heating furnace with three heating zones. Temperatures in the high temperature zone can go to 1200 C while the maximum temperature in the low temperature zone is 600 C. The temperature gradient is greater than 60 C/cm and the pressure can be down to 10^{-3} Torr. Heating zone movement speed can be varied from 1 to 54 mm/hr.

b. The Gas Evaporation Facility (GEF). This facility allows for the study of evaporation in a low-g environment as a tungsten filament heater coated with the material of interest is evaporated in a low pressure inert gas. Filament temperatures of approximately 1000 C can be obtained in pressures less than 380 Torr in a bulb with a 85 mm diameter.

c. The Organic Crystal Growth Experiment Facility (OCF). The OCF consists of a large and a small version of a three cell organic crystal growth facility. Each cell can be filled with a different material and on orbit, a valve can be opened to allow a diffusion controlled growth to take place in the center cell. On the IML-1 version of the experiment, a solvent is placed in the center cell (Anisole) and a donor liquid is placed in one cell and an acceptor liquid is placed in the other cell. As diffusion takes place, a crystal of a potentially superconducting organic metal is expected to grow. An identical version is

placed on a passive dampening material to study the influence of g-jitter on the growth process. Photographs can be taken of the crystals during growth.

APPENDIX B

GENERAL INSTRUCTIONS AND PROVISIONS

I. Instrumentation and/or Ground Equipment

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use, by the selected investigator, of Government instrumentation or property that subsequently becomes available, with or without modification, that will meet the investigative objectives.

II. Tentative Selections, Phased Development, Partial Selections, and Participation with Others

By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment, and to discontinue the investigative effort at the completion of any phase. The investigator should also understand that NASA may desire to select only a portion of the proposed investigation and/or that NASA may desire the individual's participation with other investigators in a joint investigation, in which case the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its team leader or contact point.

III. Selection Without Discussion

The Government reserves the right to reject any or all proposals received in response to this Announcement when such action shall be considered in the best interest of the Government. Notice is also given of the possibility that any selection may be made without discussion (other than discussions conducted for the purpose of minor clarification). It is, therefore, emphasized that all proposals should be submitted initially on the most favorable terms that the offeror can submit.

IV. Foreign Proposals

See Appendix C, Section II, paragraph 3.

V. Treatment of Proposal Data

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal or quotation and specify the information, subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

RESTRICTION ON USE AND DISCLOSURE OF

PROPOSAL AND QUOTATION INFORMATION (DATA)

This information (data) contained in [insert page numbers or other identification] of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

VI. Status of Cost Proposals (U.S. Proposals Only)

The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that following selection and during negotiations leading to a definitive contract, the institution will be required to resubmit or execute a Standard Form (SF) Form 1411 "Contract Pricing Proposal Cover Sheet" and all certifications and representations required by law and regulation.

VII. Late Proposals

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, should such action be in the interest of the Government.

VIII. Source of Space Transportation System Investigations

Investigators are advised that candidate investigations for Space Transportation System (STS) missions can come from many sources. These sources include those selected through the Announcement of Opportunity, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.

IX. Disclosure of Proposals Outside Government

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal the investigator and institution agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desire to preclude NASA form using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. Equal Opportunity (U.S. Proposals Only)

By submitting a proposal, the investigator and institution agree to accept the following clause in any resulting contract:

EQUAL OPPORTUNITY

During the performance of this contract, the Contractor agrees as follows: *

1. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

2. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (a) employment, (b) upgrading, (c) demotion, (d) transfer, (e) recruitment or recruitment advertising, (f) layoff or termination, (g) rates of pay or other forms of compensation, and (h) selection for training, including apprenticeship.

3. The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

4. The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

5. The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding the notice to be provided by the Contracting Officer, advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

6. The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

7. The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor, Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within 30 days following the award, unless filed within 12 months preceding the date of award.

8. The Contractor shall permit access to its books, records, and accounts by the contracting agency or the Office of Federal Contract Compliance Programs (OFCCP) for the purposes of investigation to ascertain the Contractor's compliance with the applicable rules, regulations, and orders.

9. If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, the contract may be cancelled, terminated, or suspended in whole or in part, and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.

10. The Contractor shall include the terms and conditions of subparagraph 1 through 9 of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

11. The Contractor shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

XI. Patent Rights

1. For any contact resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 18-52.227-70, "New Technology," shall apply. Such contractors may, in advance of contract, request waiver of rights as set forth in the provision at NFS 18-52.227-71, "Requests for Waiver of Rights to Inventions."

2. For any contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, "Patent Rights--Retention by the Contractor (Short Form)" (as modified by NFS 18-52.227-11), and the clause at NFS 18-52.227-73, "Patent Rights Clause for Subcontracts," shall apply.

APPENDIX C

GUIDELINES FOR PROPOSAL PREPARATION

I. Letter of Endorsement (Cover Letters)--These shall be signed by an official of the PI's organization who is authorized to commit the organization to the proposal and its contents.

II. Table of Contents

III. Identifying Information (Title Page)--This page should contain the legal name and address of the organization and specific division or department if part of a larger organization; type of organization (e.g., profit, nonprofit, educational, etc.); identification of the specific AO to which the proposal is responding, a brief title for the proposed project; names, addresses, and phone numbers of the PI and all Co-I's; date of submission; proposed start date and dates of project duration; and amount of funding requested of NASA. If the proposing institution is willing to share in the cost of the project, this should be indicated.

SECTION I

INVESTIGATION AND TECHNICAL PLAN

The text addressing the requirements of this section should be as concise as possible but should contain a complete description of the proposed work and its rationale. A maximum of twenty (20) pages (8 1/2 X 11, 10 or 12 pitch), single spaced, is to facilitate effective review. Support documentation including preprints, manuscripts, or detailed derivations should be referred to appendices.

1. INVESTIGATION AND TECHNICAL PLAN

   a. Proposal Summary--The proposal should be prefaced with a concise abstract of no more than two single spaced typewritten pages which state the research objectives, scientific or technical significance, the relevance to the AO objectives, a brief indication of how the proposed research will be accomplished, and the anticipated results.

   b. Objective and Significant Aspects--This section must include a short explanation of the objectives of the proposed research, background material describing scientific basis and rationale for developing the proposal, and requirement for space environment in achieving a successful result. Proposers are encouraged to define explicit hypotheses that will be tested and/or evaluated by the proposed project. The proposed investigation should be defined in relation to important scientific problems or the current state of the art in the area being investigated. The significance of the proposed study should be defined in terms of its relationship to earlier studies of a similar nature and/or the implications of the anticipated results. The proposal should attempt to characterize the relative degree of innovation associated with the objectives or approach on the proposed study and the importance of the anticipated results in relation to the current state of knowledge within particular disciplinary fields. The extent to which the anticipated results will influence the definition and conduct of future research projects on similar or related topics should be discussed in the proposal.

   c. Investigation Approach--The main body of this section should present a detailed technical description of the proposed work, including all tasks to be performed. The concept of the investigation should be clearly stated and the methods employed in data acquisition, analysis, and interpretation should be presented. It should also include objectives, justification for the space environment, anticipated results, significance,

and relationship to the present knowledge or technology, how it complements other work in the field, as well as methods for accomplishing the objectives. Ancillary types of data required should be clearly identified.

The proposer should recommend the equipment to meet the science requirements and should provide an estimate of any required changes in capabilities.

2. INSTRUMENTATION

Since this AO is requesting experiments that will be performed in equipment that will be provided by NASA, the proposal should only address experiment specific equipment that will be provided by the PI. This section should describe all information necessary to plan for experiment development, integration ground operations, and flight operations. This section must be complete in itself without the need to request additional data. Failure to furnish complete data may preclude evaluation of the proposal.

a. Instrument Description--This section should fully describe the instrumentation and indicate items which are proposed to be developed, as well as any existing instrumentation. Performance characteristics should be related to the experiment objectives as stated in the proposal.

b. Instrument Integration--This section should describe all parameters of the instrument pertinent to the accommodation of the instrument in the spacecraft, Spacelab, or Shuttle Orbiter. These include but are not limited to volumetric envelope, weight/power requirements; thermal requirements; telemetry requirements; sensitivity to or generation of contamination (e.g. EMI, gaseous effluents); data processing requirements.

c. Ground Operations--This section should identify requirements for prelaunch or postlaunch operations support.

d. Flight Operations--This section should identify any requirements for flight operations support, including mission planning. Operation constraints, viewing requirements, and pointing requirements should all be identified. Details of communications needs, tracking needs, and special techniques, such as restrictions in the use of control thrusters at stated times should be delineated. Special communications facilities that are needed must be described. Any special orbital requirements, such as time of month, of day, phase of moon,

and lighting conditions are to be given in detail. Describe real-time ground support requirements and indicate any special equipment or skills required of ground personnel.

3. DATA REDUCTION AND ANALYSIS

This portion of the proposal must provide a discussion of the data reduction and analysis plan including the method and format. It must include in-flight and post-flight characterization techniques, special equipment required, and types of data to be obtained during the flight. A section of the plan should include a schedule for the submission of final results and publication plans. Any pertinent housekeeping or ancillary data requirements should be specified.

4. ORBITER CREW AND/OR PAYLOAD SPECIALIST TRAINING REQUIREMENT

A description of the tasks required of each crew member (Commander, Pilot, Mission Specialist) or payload specialist should be provided, including the task duration and equipment involved. Indicate special training necessary to provide the crew members or payload specialists(s) with the capability for performing the aforementioned tasks.

SECTION II

MANAGEMENT PLAN AND COST PLAN

A. MANAGEMENT PLAN

The management plan should summarize the management approach and the facilities and equipment required. Additional guidelines applicable to non-U.S. proposers are contained herein:

This portion of the proposal must clearly define and delineate the responsibilities of the PI and all Co-Is, the organization of these within the group, and the percentage of time (based on the man-year equivalents [MYE]) each member has dedicated to the project. This section should also include facilities/capabilities available to the investigators (e.g. hardware, software, etc.) It also should describe requirements for access to any NASA facilities and expertise.

1. MANAGEMENT

a. The management plan sets forth the investigator's approach for managing the work, the recognition of essential management functions, and the overall integration of these functions.

b. The management plan gives insight into the organization proposed for the work, including the internal operations and lines of authority with delegations, together with internal interfaces and relationships with the NASA major subcontractors and associated investigators. Likewise, the management plan usually reflects various schedules necessary for the logical and timely pursuit of the work accompanied by a description of the investigator's work plan and the responsibilities of the co-investigators.

c. The plan should describe the proposed method of instrument acquisition. Specifically, it should include the following, as applicable.

(1) Rationale for the investigator to obtain the instrument through or by the investigator's institution.

(2) Method and basis for the selection of the proposed instrument fabricator.

(3) Unique or proprietary capabilities of the instrument fabricator that are not available from any other source.

(4) Contributions or characteristics of the proposed fabricator's instrument that make it an inseparable part of the investigation.

(5) Availability of supporting personnel in the institution to successfully administer the instrument contract and technically monitor the fabrication.

(6) Status of development of the instrument. What additional development is needed. Areas that need further design or in which unknowns are present.

(7) Method by which the investigator proposes to:

(a) Prepare instrument specifications.
(b) Review development progress.
(c) Review design and fabrication changes.
(d) Participate in testing program.
(e) Participate in final checkout and calibration.
(f) Provide for integration of instrument.
(g) Support the flight operations.
(h) Coordinate with co-investigators, other related investigations, and the payload integrator.
(i) Assure safety, reliability, and quality.
(j) Provide required support for Payload Specialist(s), if applicable.

(8) Planned participation by small and/or minority business in any subcontracting for instrument fabrication or investigative support functions.

2. FACILITIES AND EQUIPMENT

All major facilities, laboratory equipment, and ground-support equipment (GSE) (including those of the investigator's proposed contractors and those of NASA and other U.S. Government agencies) essential to the experiment in terms of its system and subsystems are to be indicated, distinguishing insofar as possible between those already in existence and those that will be developed in order to execute the investigation. The outline of new facilities and equipment should also indicate the lead time involved and the planned schedule for construction, modification, and/or acquisition of the facilities.

3. ADDITIONAL GUIDELINES APPLICABLE TO NON-U.S. PROPOSERS ONLY

The following guidelines are established for foreign responses to NASA's Announcement of Opportunity. Unless otherwise indicated in a specific announcement, these guidelines

indicate the appropriate measures to be taken by foreign proposers, prospective foreign sponsoring agencies, and NASA leading to the selection of a proposal and execution of appropriate arrangements. They include the following:

a. Where a "Notice of Intent" to propose is requested, prospective foreign proposers should write directly to the NASA official designated in the Announcement of Opportunity and send a copy of this letter to the International Relations Division, Code XID, NASA, Washington, DC 20546, U.S.A.

b. Unless otherwise indicated in the Announcement of Opportunity, proposals will be submitted in accordance with this Appendix excluding cost plans. Proposals should be typewritten and written in English.

c. Persons planning to submit a proposal should arrange with an appropriate foreign governmental agency for a review and endorsement of the proposed activity. Such endorsement by a foreign organization indicates:

(1) The proposal merits careful consideration by NASA.

(2) If the proposal is selected, sufficient funds will be available to undertake the activity envisioned.

d. Proposals along with the requested number of copies and letters of endorsement from the foreign governmental agency must be forwarded to NASA in time to arrive before the deadline established for each Announcement of Opportunity. These documents should be sent to:

International Relations Division
Code XID (AO No. OSSA-4-88)
National Aeronautics and Space Administration
Washington, DC 20546 U.S.A.

e. All proposals must be received before the established closing date; those received after the closing date will be treated in accordance with NASA's provisions for late proposals. Sponsoring foreign government agencies may, in exceptional situations, forward a proposal directly to the above address if review and endorsement is not possible before the announced closing date. In such cases, NASA should be advised when a decision on endorsement can be expected.

f. Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating the Announcement of Opportunity. Copies of these letters will be sent to the sponsoring Government agency.

g. NASA's Office of External Relations will then begin making the necessary arrangements to provide for the selectee's participation in the appropriate NASA program. Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

(1) A letter of notification by NASA.

(2) An exchange of letters between NASA and the sponsoring foreign governmental agency.

(3) An agreement or Memorandum of Understanding between NASA and the sponsoring foreign governmental agency.

B. COST PLAN (U.S. Investigations Only)

Section IIB: COST PLAN

The cost plan will consist of the proposed NASA funding request and any co-funding or resources to be provided by the proposing organization. The cost plan should summarize the total project costs and should include the following cost categories:

Separate schedules, by fiscal year, should be included in the above format.

The cost plan should summarize the total investigation cost by major categories of cost as well as by function.

1. The categories of cost should include the following:

a. Direct Labor--List by labor category with labor hours and rates for each. Provide actual salaries of all personnel and the percentage of time each individual will devote to the effort.

b. Overhead--Include indirect costs, which because of its incurrence for common or joint objectives, is not readily subject to treatment as a direct cost. Usually this is in the form of a percentage of the direct labor costs.

c. Materials--This should give the total cost of the bill of materials including estimated cost of each major item. Include lead time of critical items.

d. Subcontracts--List those over $25,000, specify the vendor and the basis for estimated costs. Include any baseline or supporting studies.

e. Special Equipment--Include a list of special equipment with lead and/or development time.

f. Travel--List estimated number of trips, destinations, duration, purpose, number of travelers, and anticipated dates. For planning purposes the travel list should include those trips discussed in Appendix E.

g. Other Costs--Costs not covered elsewhere.

h. General and Administrative Expense--This includes the expenses of the institution's general and executive offices and other miscellaneous expenses related to the overall business.

i. Fee (if applicable).

2. Separate schedules, in the above format, should be attached to show total cost allowable to the following:

a. Principal Investigator and other Investigators' costs.

b. Instrument costs.

c. Integration costs.

d. Data reduction and analysis including the amount and cost of computer time.

3. If the effort is sufficiently known and defined, a funding obligation plan should provide the proposed funding requirements of the investigations by quarter and/or annum keyed to the work schedule.

APPENDIX D

The activities and travel requirements described in the science proposal should include both the discretionary travel necessary to support the science objectives and that travel dictated by the inclusion of the science hardware in a fully integrated Spacelab mission. The following scenario describes those non-discretionary travel requirements which the proposer should consider in developing the Cost Plan. In cases where the Principal Investigator (PI) is selected after the onset of Spacelab mission integration activities, as will be the case for some of the science investigations of USML-1 **[Launch Readiness Date: March 1992; Earliest Date of Contract Funding: August 1989 (L-31)]**, the Payload Element Developer (PED), and Mission/Program Scientists act on behalf of the PI in order to establish early generic experiment hardware requirement parameters for the mission.

Typical Principal Investigator (PI) Spacelab Mission Integration Activities

Early Mission Preparation [Launch-42 months to Launch-24 months]

- Prepare, with the Payload Experiment Hardware Developer (PED), the Experiment Requirements Document (ERD) to indicate the payload resources desired (i.e., mass, poser, energy, crew time, hardware items, stowage needs). **[L-42 to L-36]**

- Resolve with the PED any difference between the ERD desired resources and the available payload resources. And, in order to ensure that the integrated payload design will meet the experiment science objectives, develop two mutually agreed upon basic experiment requirements documents: **[L-36 to L-18]**

    - o Instrument Interface Agreement (IIA)
    - o Operations and Integration Agreement (O&IA)

- Participate in the experiment Requirements Review (RR) [L-34] to ensure that the science objectives are being implemented in the experiment design. **[Each review typically two dedicated days at Marshall Space Flight Center]**

- PI may participate in the Integrated Payload Requirements Review (IPL RR) [L-35] and the Integrated Payload Preliminary Design Review (IPL PDR) [L-28] if there are experiment issues or concerns that will be

addressed in the review. PED's are required to participate in the integrated payload reviews. [Each review typically two dedicated days at Marshall Space Flight Center]

- Participate in Investigator Working Group (IWG) meetings beginning at L-36 and occurring approximately every six months until launch. [Each review typically two dedicated days at Marshall Space Flight Center]

- Prepare material to describe the need for Payload Specialists (PS), nomination of payload specialist candidates, and recommendations for selection of payload specialists [L-34 to L-24]. Much of this work will be included in preparation for and attendance at IWG meetings.

- Participate in experiment Critical Design Review (CDR) [L-28] to ensure that science objectives are being implemented in experiment design. [Each review typically two dedicated days at Marshall Space Flight Center]

Mid-Mission Preparation [Launch-24 months to Launch 12-months]

- Prepare and present payload specialist training on the science objectives and participation in the hardware training at the experiment hardware developer site.

- Begin planning for utilization of the Payload Operations Control Center (POCC) to support science objectives and experiment hardware capability. This includes the team that will support payload operations for two or three shifts around-the-clock during both mission simulations and the mission, and the information and facilities needed from the POCC to support the experiment operations team.

- PI may participate in the Integrated Payload Critical Design Review (IPL CDR) [L-22] and the Integrated Payload Flight Operations Review (IPL FOR)/Ground Operations Review (IPL GOR) [L-12] if there are experiment issues or concerns that will be addressed in the review. The PED's are required to participate in the integrated payload reviews. [Each review typically two dedicated days, the IPL CDR at Marshall Space Flight Center and the IPL FOR/GOR at Kennedy Space Center]

- Continue participation in the Investigator Working Group (IWG) meetings which began at L-36 and occur at approximately every six months until launch. [Each review typically two dedicated days at Marshall Space Flight Center]

Late-Mission Preparation **[Launch-12 months to Landing]**

- Continue participation in the Investigator Working Group (IWG) meetings which began at L-36 and occur approximately every six months until launch. [Each review typically two dedicated days at Marshall Space Flight Center]

- Participate in physical integration activities at Kennedy Space Center (KSC) [L-10 to 1-7] as required. [Typically no more than one dedicated week at a time at Kennedy Space Center, no more than twice during the experiment integration process]

- Participate in Mission Sequence Tests (MST) at L-6 and L-3 at KSC. [Each test will involve one dedicated week at Kennedy Space Center]

- Participate in payload specialist training on a consulting basis for experiment operations.

- Define POCC experiment operations team and participate in five mission simulations at Marshall Space Flight Center POCC. [Typically one per month from L-5 to launch, each one involving a dedicated week.]

- Participate in supporting the actual science flight mission at the POCC. [Launch to Landing, typically two dedicated weeks at MSFC]

Post Flight Activities **[Landing to L+12 months]**

- Post flight data analysis. Activities typically associated with Principal Investigator analysis of mission data at the PI's home site. [Landing to L+12]

- Provide preliminary input to support Mission Managers Report. [30 days post mission, typically no travel]

- Participate in Mission Science Results Review. [12 months after the mission, typically two dedicated days at Marshall Space Flight Center]

APPENDIX E

BIBLIOGRAPHY

Background materials available to AO investigators from NASA Headquarters upon request. Requests must be submitted in writing to:

Microgravity Science and Applications Division
Code EN AO-USML-1
NASA Headquarters,
Washington, DC 20546

Documents that may provide useful information to investigators are listed below:

Microgravity Science and Applications Division --
A Program Overview: 1986-87

Microgravity Science and Applications Program Tasks,
February 1987.

* U.S. G.P.O. 1988-201-151:80033

NASA MAILING LIST UPDATE

The NASA Office of Space Science and Applications is in the process of **Updating** and **Enhancing** their scientific investigation mailing list. Please fill out all the following information, refold the questionaire, tape it, and mail it back to the preprinted address on the reverse side. Thank you for your time.

Please check (all that apply) the type of NASA Mailings you would like to receive:

- ☐ 1. Announcements of Opportunity
- ☐ 2. Space Science and Applications Notices
- ☐ 3. NASA Research Announcements (NRA)
- ☐ 4. Please **remove** my name from NASA Mailing List

Contact Information: Salutation (Mr., Mrs., Ms., Dr., Prof., etc.) _____

Suffix (Ret., III, Phd., Jr., etc.) _____ Phone _____

ADDRESS LABEL CHANGE: If the label on reverse side is incorrect, please provide COMPLETE address information. (Foreign addresses please specify country)

NASA Address #: _____ (Obtain from address label)

First Name, M.I.: _____ Last Name: _____

Organization: _____

Address line 1: _____

Address line 2: _____

Address line 3: _____ Zip _____

Institution type (check all that apply):

- ☐ 1. College or University
- ☐ 2. International
- ☐ 3. Minority Business
- ☐ 4. NASA Center
- ☐ 5. Non-Profit Corporation
- ☐ 6. Other Government Agency
- ☐ 7. Private Industry
- ☐ 8. Small Business

Program Involvement (check all that apply):

- ☐ 1. Principal Investigator
- ☐ 2. Co-Investigator
- ☐ 3. Management/Administration
- ☐ 4. General Interest
- ☐ 5. Flight Project
- ☐ 6. Suborbital Investigation
- ☐ 7. Data Analysis
- ☐ 8. Basic Research
- ☐ 9. Advanced Planning & Mission Definition
- ☐ 10. Science Working Group
- ☐ 11. NAS/NRC Advisory Committee
- ☐ 12. NASA Advisory Council or Committee
- ☐ 13. Committee(s): _____

OSSA Involvement (check all that apply):

- ☐ 1. Astrophysics
- ☐ 2. Communications
- ☐ 3. Earth Science and Applications
- ☐ 4. Information Systems
- ☐ 5. Life Sciences
- ☐ 6. Microgravity Science and Applications
- ☐ 7. Shuttle Payload Engineering
- ☐ 8. Solar System Exploration
- ☐ 9. Space Physics
- ☐ 10. None

Discipline (check all that apply):

- ☐ 1. Astronomy
- ☐ 2. Communications
- ☐ 3. Computer Sciences/Information Systems
- ☐ 4. Environmental Observations
- ☐ 5. Life Sciences
- ☐ 6. Microgravity Sciences
- ☐ 7. Planetary Sciences
- ☐ 8. Solar and Space Physics

NASA Contractor/Grantee: ☐ Yes ☐ No

(If YES, please provide current NASA/OSSA Contract & Grant Numbers and Designate Level of Responsibility)

P - Principal Investigator
C - Co Investigator
L - Team Leader

Example: [N,A,G,W,-,1,2,3,4,5,] [P]

_____ ☐ _____ ☐ _____ ☐

_____ ☐ _____ ☐ _____ ☐

Signature: _____ **Date:** _____

Rev. 3/8/88

BEST COPY AVAILABLE

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12028 WASHINGTON, DC

POSTAGE WILL BE PAID BY ADDRESSEE

Ms. Mary Ann Gaskins
NASA Headquarters
Room 244 — Mail Code EPS
600 Independence Avenue, SW
Washington, D.C. 20546

NASA
OFFICIAL MAILING LIST
UPDATE

Mary Ann Gaskins
NASA Headquarters
Room 244 — Mail Code EPS
600 Independence Avenue, SW
Washington, D.C. 20546

Postage and Fees Paid
National Aeronautics and
Space Administration
NASA 451

Official Business
Penalty for Private Use $300

BEST COPY AVAILABLE

National Aeronautics and
Space Administration

Washington, D.C.
20546

Official Business
Penalty for Private Use $300

FIRST-CLASS MAIL
POSTAGE & FEES PAID
NASA
PERMIT No. G27

END

DATE FILMED

01-23-92